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SECTION C

STRESS AND DISEASE: THE CONCEPT AFTER 50 YEARS†

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Abstract—Although there is no generally accepted definition of 'a state of stress' in biological or social systems, biologists and social and behavioral scientists continue to use the term. They communicate meaningfully by describing and measuring sources of stress and their observed effects on living organisms, without attempting to define the intervening variables. Biologists and medical scientists tend to be concerned with sources of stress that are concrete and observable, and can otherwise be considered as 'causes' of illness and injury; social and behavioral sciences tend to be concerned with sources of stress that represent information that arises from outside the person and is mediated by higher centers of the central nervous system. It is clear that such "psychological stresses' can lead to alterations of internal functions down to the biochemical level, and that they are potential 'causes' of disease; but they do not usually act independently of other mechanisms.

The central thesis of the stress theory of disease, as elaborated by Cannon and Selye, appears to have been thoroughly established. Disease can be regarded as a phenomenon that occurs when an agent or condition threatens to destroy the dynamic steady state upon which the integrity of the organism depends; and the manifestations of disease appear to be, in large measure, manifestations of the organism's efforts to adapt to, and to contain, threats to its integrity. In this sense, all diseases are to some extent disorders of adaptation. Also, it appears that the course and manifestations of any disease can be influenced to some extent by activities of the nervous and endocrine systems that are initiated by the central nervous system in response to information from the social and interpersonal environment. On the other hand, the theoretical explanation of how 'stress' causes disease, which was developed in the 1930s and 1940s and based on a hypothetical 'state of stress' within the organism, as a model derived from engineering concepts, is clearly incorrect. The relation of an organism to its environment is, in large measure, a communicative interaction. Its response to a threat to its integrity is based upon the evaluation of the information received. This response is not random and non-specific, but directed, and it is as highly specific as the effector mechanisms of the organism can make it.

Key words—stress, stress theory, stress disorders, psychological stress

In 1972, for a meeting of this group, I prepared a paper titled "The Concept of Stress in the Biological and Social Sciences," which, among other things, questioned whether or not there was any scientifically meaningful definition of the term 'stress' as applied to biological and social systems [1]. There is still today no generally agreed upon definition of 'stress' in such systems that allows anyone to determine unequivocally when the state exists and to categorize it as present or absent, if not to measure it. Nevertheless, biological, social and behavioral scientists have continued to use the term. The 1985 edition of the Cumulated Index Medicus [2] lists more than 1100 scientific articles relating to 'stress' or its effects in biological and social systems, 'stress disorders' and 'psychological stress'. So much for my objections.

Since the scientists who use the term 'stress' can be presumed to be communicating with each other in a meaningful manner, one must assume that they share a common general understanding of its meaning, and that the concept of 'stress' continues to have a heuristic usefulness. It is worthwhile, therefore, to consider what the source of common understanding may be; whether it is different for scientists in different fields; how it relates to the concept of 'stress' as Cannon [3] and Selye [4, 5] used it a half century ago; and where we now stand on the question of 'stress and disease'. This is the burden of this essay.

From a perusal of the titles of scientific articles, and of some of the relevant literature, it is evident that authors in the biological and social sciences have tended to avoid a definition of the 'state of stress'. On the other hand, they have usually provided a description of the source of the stress, which in many cases they measure or quantify rather precisely. The basis for effective communication arises when there is a detailed and quantitative description of the source of the 'stress', and of one or more measurable effects upon the system that is being 'stressed'.

In the biological literature, one finds that authors have used the term 'stress' in relation to single organisms, populations of organisms, and ecosystems. Since our interest is in the effect of stress upon 'health', our concern at this time is how biologists use the term in relation to single organisms. This is true because 'health', and 'illness', as these terms are used in the medical sciences, are phenomena of people as individuals. Medical scientists do speak of the 'health' of human populations, but when they do so, they actually speak of the cumulated mani-

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†[A Special Issue devoted to Stress will shortly be appearing—ED.].

festations of mortality, morbidity, disability and impairments of the individual members of a population. The 'health' of human societies, as such, or of human ecosystems, are concepts outside of the medical sciences.

When biological scientists describe the sources of stress for individual organisms, one sees that they refer variously to conditions that arise within the organism, such as dehydration or depletion of stores of fat or carbohydrate; to conditions that arise outside of the organism, such as heat, cold, or an inadequate food supply in the environment; to the impingement of agents or energy from outside the organism, such as micro- or macro-predators, or physical trauma; and to information from outside of the organism, such as that arising from the presence of other organisms that are perceived as hostile. The common feature of all of these 'sources of stress' is that they have the effect of perturbing the dynamic steady state upon which the life of the organism depends, or of threatening to do so. The implication is that the organism must adapt to the effects of these 'sources of stress' in order to survive. The adaptation, even if successful in preserving life, may transiently or permanently limit the ability of the organism to carry out some of its functions or activities, and may involve structural damage to the organism that can be permanent and severe.

When human biologists, who are for the most part medical scientists, speak of the 'sources of stress' that affect the human organism, and especially when they describe their observations from experimental and clinical studies, the 'sources of stress' that they most often speak of are concrete and observable phenomena that are otherwise described as 'causes' of illness and injury: microbial infections; trauma; abnormalities of food or fluid intake; the ingestion of toxic substances; external conditions such as heat or cold; and internal conditions such as those created by stroke, vascular occlusion, or hemorrhage. In the terms of the medical sciences at the present time, most of the 'causes' of disease and death may be described otherwise as 'sources of stress' for the organism. Similarly, the impairments of function and many of the changes in structure that occur as a part of the adaptation to these 'sources of stress', represent a major part of manifestations of the 'diseases' or 'injuries' that they produce. In this sense, it now appears that all of the manifestations of disease and injury that occur to people may be regarded as being produced, to a greater or lesser extent, by adaptations to sources of 'stress'. If one regards the concept of 'disorders of adaptation' as proposed by Selye in 1946 [4], as including any disease that is wholly or in part manifested by an adaptation to a source of stress, then this category now includes all diseases.

Forty years after Selye, physicians in general and many psychologists remain ambivalent about whether information arising from outside of a person and mediated only by the higher centers of the central nervous system, can 'cause' bodily disease. 'Stresses', which originate in this manner and are mediated in this way, are the ones that are most frequently called 'psychological stresses'. Much of the past and present scientific literature relating to 'psychological stress' has been concerned with experimental and clinical evidence that information acquired from the social and interpersonal environment and mediated by the central nervous system through its control of internal regulatory processes, *is* able to produce alterations of internal functions down to the biochemical level. At the present time there is no reason to doubt that information acquired and mediated in this manner is a potential 'cause' of disease. However, clinical and epidemiological observations suggest that this kind of information rarely operates by this mechanism alone. It often operates also through changes in gross motor behavior, through changes in patterns of activity, through changes in exposure to infection or trauma, and through changes in the ingestion of food, fluid, and substances such as cigarettes, alcohol, and medications. Probably for this reason, there has been a reluctance to see this mechanism as a sole instigator of bodily illness. Possibly for this reason also, investigators and observers of 'psychological stress', have tended to focus upon its effects on the higher functions of the central nervous system—the changes in mood, thought, and behavior—that are its most immediately evident effects.

Social scientists and others who have concerned themselves with the 'stress' that arises from a person's relation to the society in which he lives, have usually spoken of 'stress' as if they meant 'psychological stress', much in the sense that psychologists usually speak of such stress. Sources of stress of the kind that the biologists speak of are usually not treated in the category of 'stress' in the social science literature. When there is a discussion of a subject such as the agricultural practices of a society and their relevance to the presence of cystercercosis, beri-beri, or protein-calorie malnutrition, the parasites, and the deficiencies of vitamins, proteins, or calories in the food are not usually described as 'stresses'. The 'stress' paradigm in the social sciences (as perceived by this medical scientist) is, in general, based on the assumption that each human society prescribes a variety of forms of behavior that are proper for its members, with a variety of proper relationships between these members, and a number of proper functions for each of them; and that all of these vary with variations in the role of the individual. The prescribed forms of behavior and relationships are internalized by the individual as guidelines and values. The society usually provides sanctions for those who move outside the proper range of relationships and behavior. In such a system, 'stress' occurs for a person when he is faced with a situation that implies for him two or more different kinds of behavior, based on two or more different sets of guidelines and values, which are in conflict and are not readily reconcilable.

That encounters with this kind of 'stress' are a common feature of the lives of people in modern societies is abundantly evident. Moreover, history and literature, both scientific and popular, make it evident that people in all human societies have encountered such 'stress', that it has been a potent cause of emotional turmoil and disturbed behavior, and that illness and death, by whatever mechanism, have often followed as apparent consequences of the encounter. However, when one poses questions such as whether this kind of 'stress' is more common in one society than in another, to what extent it

accounts for the morbidity and mortality within a society, by what mechanism it does so, and whether or not this kind of 'stress' should be considered as distinct from other kinds of 'stress' that biologists have considered, the answers are not readily forthcoming.

That encounters with 'social stresses', as we have just described them, should be a feature of life in any human society seems to be implied by the very nature of human societies. Human social groups, like animal social groups, are fundamental biological organizations. It is elementary that people do not exist except as members of social groups. Each person owes his very origin to two other people and his continued existence to many others, if only for the means of obtaining food, clothing, and shelter. The sociobiologists have presented evidence that animal social groups are adaptive, and have survival value so far as the species is concerned, but not ultimately so far as the individual member of the species is concerned [6]. The individual animals in a social group do tend to thrive because the existence of the group provides a better supply of food and a greater protection from ecological threats; but the group, as a group, does not behave as if the welfare of the individual members were the purpose for its existence. It behaves, rather, as if its purpose were to direct the genetic inheritance of the species toward an optimal configuration for the survival of the species. It provides for competition among its members—often mortal—for the privileges of reproduction. It produces an excess of offspring with the expectation that many of the weak will die. It allows the aged, the ill, and the injured to die also; and it provides roles for certain members of the group in the defence of the group and its offspring, which often imply that those who occupy these roles will die also.

That human societies behave as if the welfare of the social group were ultimately more important than that of any individual member is clear; but whether the ultimate adaptive purpose of modern human social groups is to preserve and enhance the genetic inheritance of the species is at least debatable. Modern human societies appear to be concerned with the welfare of their individual members to a degree that is entirely 'unnatural' in terms of the behavior of other species. They attempt to preserve the lives of all human offspring including the weak, the defective, and those with genetically transmittable disorders. They attempt to prevent diseases and injuries of all sorts, to whomever they occur. They protect the ill, the disabled, and the aged, and they attempt to guarantee for each member of the society his full biological span of life. Some modern societies have been so successful in providing these measures of good health for their members that the effort consumes a significant proportion of all the goods and services that these societies produce.

Such concern for the welfare of the individual does not, however, provide convincing evidence of a greater altruism among modern *homo sapiens* than among any other species. It is probably an outgrowth of the explosive and highly successful development of the cultural adaptation by mankind during the last 10 million years. The development of tool using, tool making, and, especially, of language, has meant that information acquired by the individual human during his own lifetime can be transmitted to other individuals directly and immediately, bypassing entirely the much slower method of genetic inheritance. The development of writing and other means of recording and transmitting information has created a vast store of information outside of any individual member of the species, and potentially accessible to all. This, along with the extraordinary elaboration of human societies, and the minute divisions of labor within them, has greatly enhanced the value of the individual human as such. A person with special skills and knowledge has great value for the group as a whole, even though he may be aged, infirm, or the carrier of a genetic defect. His knowledge and his skills can contribute significantly to the information available to the group, and can be readily transmitted to others or recorded for the use of all. His roles within the group contribute additionally to his value.

One need not be a Beethoven or a Newton to qualify for the self-serving altruism of a modern human society. A mechanic or a farmer, or almost any other modern human, is no undifferentiated *homo*. His skills and knowledge and his value for his own group are usually well worth the group's efforts to preserve them. In addition, his roles in his family, in his employment, and in his social group, and his relations to other members in the group make them, to a greater or lesser extent, dependent on him, and upon his activities. These too provide them with good reason to be concerned for his welfare. All of which suggests that modern societies are behaving more and more as if the primary focus of their adaptive efforts were shifting from the preservation and enhancement of the genetic inheritance of the species to the preservation and enhancement of its cultural inheritance, which has become the primary mode of human evolution during the last 300,000 years.

The temporary effect of the outwardly altruistic concern of modern societies for their individual members does not, of course, mean that these societies are any more free of constraints on the behaviour of their members than were primitive societies, or even animal societies. Indeed, there is much reason to believe that, for the individual, the constraints on his behavior in modern human societies are much larger in number and more detailed than they were in the past, and that they have increased rapidly during the past 300 years with the development of clocks, artificial lighting, and modern methods of communication, transportation, manufacturing and commerce. Modern industrial societies that provide a high standard of living and a long life for their members also provide them with schedules for their daily round-of-life—for when they must get up, must go to work, and when they must carry out many other activities and duties during the course of the day, as well as when they must pay their bills, celebrate their holidays and pay their taxes. They prescribe for them what kind of work they must do and how they must do it, as well as how they must dress, drive their automobiles, and carry out a very great number of their other daily activities. The modern transportation within these societies moves their members about every day on timed and often trying schedule, and the modern communication sys-

tems inform their members rapidly and repeatedly of interpersonal, social, and natural phenomena that are often threatening or anxiety-producing for them. At the same time modern societies, like older societies, continue to prescribe the forms of relationships between their members, and to constrain their opportunities for the expression of their aggression and the satisfaction of their biological needs. Perhaps more than ever in the past, these societies create manifold opportunities for their members to experience frustration, conflict, uncertainty and insecurity. On the surface it might appear that 'psychological stress', as we have recently defined it, is potentially a much more important cause of illness in modern societies than the more 'physical' causes of stress, such as infection, injury, or starvation, which have been the major source of concern of biological scientists and which appear to have been significantly alleviated by modern societies.

So far as I am aware, the data that would allow one to obtain a quantitative answer to this hypothesis about the relation of 'stress' to illness in modern societies do not exist. However, it is possible to look at one of the much studied diseases that are prevalent in modern societies to see how much of what kind of 'stress' appears to be primarily involved in its genesis. Arteriosclerotic heart disease (a.k.a. 'coronary heart disease' or 'ischemic heart disease') comes to mind immediately in this context. It has been, in some ways, the quintessential disease of the industrial societies of the 20th century. One of its most characteristic manifestations, the 'acute myocardial infarction', was first recognized as a diagnostic entity during the first two decades in this century. A second, 'unexpected sudden death', became increasingly prevalent during the first half of the century, until, in the 1950s, it was recognized as the most frequent single cause of death in the United States. Even 'angina pectoris', the oldest of its widely recognized manifestations, is relatively new as a diagnostic entity; it received its name and its first description in the late 18th century.

One can surely say that the increased prevalence of these three manifestations of ischemic heart disease during the last three centuries, and especially during the present century, has been a product of modern human society, if only in the sense that the great majority of the cases of myocardial infarction, angina pectoris, and sudden death occur to people beyond the age of 50—and such people were a smaller proportion of the population of western Europe and America 300 years ago than they are today. However, one cannot say that the disease did not exist before that time, even though the number of people who had it appears to have been fewer. Arteriosclerosis, which is the basis for the disease, has been found in Egyptian mummies; the 'sudden deaths' of men, and especially of old men, have been described sporadically since ancient times; and sometimes fatal attacks of 'acute indigestion' and other kinds of rapidly fatal abdominal and chest pain, some of which may have represented myocardial infarctions, have been described throughout recorded history.

Nevertheless, it is evident that the disease is much more prevalent in modern societies than it was in the past. This appears to be the case not simply because it is a disease of older people, but also because it is a disease of well-nourished people who have a high caloric intake and a high intake of saturated fat, and because the probability of its occurrence is enhanced by a low level of physical activity. People whose caloric intake is at a subsistence level, who consume very little red meat or animal fat, and who do a great deal of physical labor, may not have the disease. Relative under nutrition and hard physical labor have been the lot of the great majority of mankind since the species evolved. It was only with the development of agriculture and of complex human societies that a relative excess of food became available for a privileged minority of the population, some of whom were also relatively protected from physical exercise. It was the members of this privileged minority who, in ancient Egypt, were much more likely to be mummified after they died, and who, in any era, have been more likely to have their illnesses described by historians or biographers. The disease apparently did not become widespread in any population until the middle of the 18th century, after technological progress in agriculture and a rising standard of living made it possible for an increasing number of people in Europe and in America to consume ever larger amounts of red meat, lard, butter, and milk in their diets. This dietary abundance became steadily more prevalent until, in the first half of the 20th century, one found large segments of national populations in countries such as the United States and Finland, in which 40% or more of the dietary calories came from fats.

Was this a disease of 'stress'? In a biological sense, it was. A constant and heavy dietary influx of saturated fat is a source of 'stress' for a human organism in the sense that biologists use this term. In order to transport the fat through the blood stream, the liver of the man who consumes so much fat is forced to create large amounts of cholesterol. With the passage of time more and more of this cholesterol becomes trapped in the lining of the arteries, where it builds up to the point at which it begins to limit the blood supply to organs that are served by these arteries, at first partially or transiently at times of high demand (as in angina pectoris), and later totally and permanently (as in myocardial infarction). Following the classical formulation of Selye, it is the adaptation to the source of 'stress' (that is, the manufacture of cholesterol), rather than the source of 'stress' itself (the excess of fat), which creates the manifestations of the 'disease'.

Common clinical experience, as well as epidemiologic evidence, indicates that this source of 'dietary stress' does not act alone to produce ischemic heart disease. The excess of calories, and the relative obesity that accompanies it, exacerbates, if it does not cause, the hypertension that is often present also. Hypertension creates myocardial hypertrophy and leads to myocardial failure, both of which render the heart more vulnerable to the effects of ischemia caused by arterial narrowing and occlusions, and greatly increase the likelihood of angina pectoris, myocardial infarction, and sudden death.

It appears also that some effects of the 'psychological stresses' that have always been a feature of life in human societies, have been directed peculiarly at

the human vascular system in modern societies because of a method that many modern people have used to alleviate the symptoms of these 'stresses'. Since neolithic times men had used beer, wine, and other alcoholic drinks, and sometimes various drugs, to alleviate the discomfort, fatigue, and anxiety that they experienced during their daily lives; but it was only during the last four centuries, and especially during the last century, that European people began to use tobacco for this purpose. The use of tobacco appears to be, among other things, a specific threat to the vascular system.

One might say that the use of tobacco has had a special attractiveness for people in modern societies. Alcohol and other drugs have the disadvantage that they impair the functions of the higher centers of the central nervous system, and thus impair people's ability to perform a large number of the many activities that modern people must carry on during their daily lives. Tobacco does not have this effect. The pipe of tobacco or the cigar provides a sense of well-being without creating drunkenness.

Pipes and cigars were, of course, the forms of tobacco that were used mostly during its first three centuries. They were used mostly by men, and were consumed mostly after meals, and their overall effect in causing disease was relatively small. Cigarettes, which were developed toward the end of the 19th century and became popular at the end of World War II, became much more widely used. They were acceptable to women as well as to men. They were cheap, and convenient, and they could provide a brief lift or a moment of relaxation for almost anyone at any time without significantly impeding his ability to perform even the most complex of mental tasks. During the first half of the 20th century, cigarettes became the 'small beer' of the great majority of people in modern industrial societies. But cigarettes not only have the great disadvantage of causing cancer; they have another also. Substances inhaled when cigarettes are smoked cause damage to the lining of the blood vessels and enhance the likelihood that accumulations of cholesterol will occur in them. Cigarette smoking appears to have contributed markedly to the increase of angina pectoris, myocardial infarction, and sudden death in modern societies.

There is also, of course, the possibility that the neurally mediated effects of the 'pace of life', and the 'pressures and tensions' of living in the modern world may have helped to increase the prevalence of the manifestations of ischemic heart disease, also. In a certain sense, this does appear to be true. In the United States both myocardial infarctions and sudden arrhythmic deaths do occur with a statistically significant excess of frequency in the morning hours when people are alert [7]. Arrhythmic deaths also occur with more than the expected frequency when people are alert, aroused, and active, and with less than the expected frequency when they are resting, asleep, or inactive [8]. Files of clinical histories of people who died suddenly usually include many examples of sudden deaths or myocardial infarctions that occur after heated arguments, exciting events, or strenuous exercise. There is very good reason to believe that alertness and arousal increase the probability of angina pectoris, myocardial infarction, and sudden arrhythmic death.

However, when one looks more closely at the data relating to all of these events, one sees, for example, that the vast majority of the sudden deaths that occur to people under circumstances of excitement or activity, occur after activities such as running for a bus, or pull-starting a lawn mower, and that those who die under these circumstances have engaged in these and similar activities many times before without dying. In addition, one sees that many of the people who die suddenly, die during or after activities such as urinating or defecating, which cannot easily be considered as 'stresses of modern life' [9].

When one examines the clinical data from cases such as these prior to their death and the results of autopsy examinations after the deaths, one finds almost without exception, that those who die suddenly are people with pre-existing heart disease, who usually have myocardial ischemia, and often have myocardial hypertrophy and myocardial failure, as well as damage to their cardiac conduction systems at the time they die—and a significant proportion of these people also have had recent acute myocardial infarctions, which have been 'silent'. The activity in which they were engaged at the time of death seems simply to have triggered an arrhythmia in a heart already damaged by atherosclerosis and hypertension. That such an activity can, in fact, be a trigger for an arrhythmia in such a heart, there seems to be little doubt—both experimental and clinical evidence indicate that the neural effects of CNS arousal, for example, can increase myocardial irritability, and that in its aftermath there may be a significant effect upon cardiac impulse formation. The case with acute myocardial infarction is similar. Even though infarctions occur more frequently when people are alert, a very large proportion of them occur to people with underlying arteriosclerosis, or myocardial hypertrophy, most of whom have also experienced the 'risk factors' of elevated blood lipids, cigarette smoking, and hypertension.

'Type A' behavior, as a behavior pattern, has typified the theoretical formulations that have been put forward to relate 'psychological stress' and 'social stress' to coronary heart disease. However, 'type A' has not proved to be persuasive as an important risk factor outside of the group in which it was originally described [9]. Although one can readily believe that people who exhibit type A behaviour are more aroused more of the time than many other people, more than CNS arousal by itself appears to be necessary for the occurrence of myocardial infarction.

In several American groups, as well as in Europe, a low level of education, both alone, and in conjunction with a low level of income, has been associated with a relatively high risk of myocardial infarction and arrhythmic death. However, this social variable, too, appears to be a surrogate for other 'risk factors' that lie behind them. In the American groups people with relatively higher levels of education have, on the whole, been less obese, with lower cholesterol levels and less hypertension, and they have been less likely to smoke cigarettes than less well-educated people

in the same group [10]. There is much to suggest that the negative gradient of cardiovascular disease with education in American society exists because this social variable is systematically related to biological variables. However, it seems quite possible, also, that this association may be, in part, a result of a greater appreciation by better educated people of the significance of the risk factors that are associated with the occurrence of heart disease.

The experiences with coronary heart disease thus provides some indication of where the 'stress theory' of disease, which was initiated by the work of Cannon and Selye, stands today. Its central thesis appears to have been thoroughly established. A disease—any disease—appears to be a phenomenon that occurs when an agent or condition threatens to destroy the dynamic steady state upon which the integrity of the organism depends. The manifestations of disease—any disease—appear to be, in large measure, manifestations of the organism's efforts to adapt and to contain threats to its integrity. In this sense, all diseases can be considered to be 'disorders of adaptation', as Hans Selye described some of them to be. It can also be considered to be established that the course and manifestations of any disease can be influenced to some extent by activities of the nervous and endocrine systems that are initiated by the central nervous system in response to information from the environment—including the social and interpersonal environment. The process is very like that which Cannon, Selye, and Harold Wolff described [11]. Thus the substance of the 'stress theory of disease' appears to be correct, and it is generally accepted to be so.

On the other hand, the theoretical explanation of how 'stress' causes disease, which was developed in the 1930s and the 1940s and based on a hypothetical 'state of stress' within the organism, as a model derived from engineering concepts, is clearly incorrect. The relation of an organism to its environment is in large measure a communicative interaction. Its response to a threat to its integrity is based upon the evaluation of the information received. This response is not random and non-specific, but directed, and it is as highly specific as the effector mechanisms of the organisms can make it. It is only because of the limited number of these effector mechanisms and the limited extent to which they can be targeted on a given threat that the response appears to be 'non-specific'.

The implication of this for social science and medicine appears to me to be quite positive. There can be no doubt that the form and structure of human societies, their institutions and their practices profoundly affect the nature of the human diseases that occur among their members. The mechanisms by which they do so are complex, multiple, and interacting. 'Psychological stress' is only a small part of these. Social scientists should feel free to look at any of the mechanisms that are involved and at their interactions. It is too restrictive, for example, simply to look at the time- and schedule-generated sympathetic arousal of employed people in industrial societies as a factor in the genesis of myocardial infarction.

There are many important questions relating to disease that appear to be apt for investigation by social scientists. In the broadest sense social scientists have an opportunity to ask questions about disease and its prevention that might not readily occur to biological scientists. In a society that can produce adequate amounts and kinds of food, shelter, clothing, sanitation, and immunization for its members, could the general education of all people become one of the single most cost-effective, public health measures? If one dissuades people from using a given 'stress-relieving' procedure, such as smoking cigarettes, may they not turn to other procedures to obtain a 'transient lift', a relief from anxiety, and a feeling of well-being? Might it be socially profitable to attempt to develop a substance that, like tobacco, might be non-intoxicating, but also non-addictive, and not damaging to the organism in any other ways? To what extent is it desirable to reduce the 'stress of modern life' in a society that bases its evolution on culture change and technological advances, and on the diversity and plasticity of social structures and processes? May not some degree of insecurity and anxiety and some sense of urgency be both expected and desirable among the members of such a society? May it not be true that social change and culture change are more important to the society than the tranquillity and feeling of security of its members and their freedom from symptoms?

Questions such as these, which are now 'far-out' are perhaps no further out than the question of 'stress and disease' was in the 1930s, at a time when all of the manifestations of disease were considered to be caused directly by infectious agents, trauma, dietary deficiencies, toxic materials, and other external agents. They seem to be waiting for social scientists to have a look at them.

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